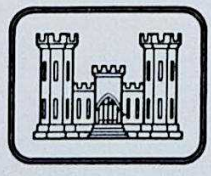
WATERPOWER '79

an international conference on small-scale hydropower

October 1-3, 1979

EXECUTIVE SUMMARY

U.S. ARMY CORPS OF ENGINEERS



U.S. DEPARTMENT OF ENERGY

CONFERENCE CO-CHAIRMEN

Lt. Gen. J.W. Morris, Chief of Engineers, U.S. Army Corps of Engineers
George S. McIssac, Assistant Secretary, Resource Applications, U.S. Department of Energy

STEERING COMMITTEE

Brig. Gen. Hugh Robinson, Chairman, Deputy Director, Civil Works, U.S. Army Corps of Engineers
James R. Hanchey, Acting Director, Institute for Water Resources, U.S. Army Corps of Engineers
Richard McDonald, Resource Manager, Hydroelectric Program, U.S. Department of Energy
Alex Shwaiko, Chief, Planning Division, Office of the Chief of Engineers, U.S. Army Corps of Engineers

TECHNICAL PROGRAM COMMITTEE

David Zoellner, Chairman, Institute for Water Resources, U.S. Army Corps of Engineers
Margaret McClements Lambie, Small Hydroelectric Resource Development Program, U.S. Department of Energy
Sharon Blake, Institute for Water Resources, U.S. Army Corps of Engineers
Lu DuCharme, Office, Chief of Engineers, U.S. Army Corps of Engineers
Darrell Nolton, Institute for Water Resources, U.S. Army Corps of Engineers

WORKSHOP PROGRAM COMMITTEE

Margaret McClements Lambie, Chairman, Small Hydro Program Staff, U.S. Department of Energy
David Auslam, President, Auslam & Associates
Peter Brown, Energy Law Institute, Franklin Pierce Law Center
Ralph Burr, Small Hydro Program Staff, U.S. Department of Energy
Ronald Corso, Federal Energy Regulatory Commission, U.S. Department of Energy
Stephen G. Hildebrand, Oak Ridge National Laboratory, U.S. Department of Energy
Robert Philleo, Engineering Division, U.S. Army Corps of Engineers
George Smith, Idaho National Engineering Laboratory, U.S. Department of Energy
Edward Tanzman, Argonne National Laboratory, U.S. Department of Energy
David Willer, Head, Water Resources Program, Tudor Engineering Co.

PARTICIPATING ASSOCIATIONS

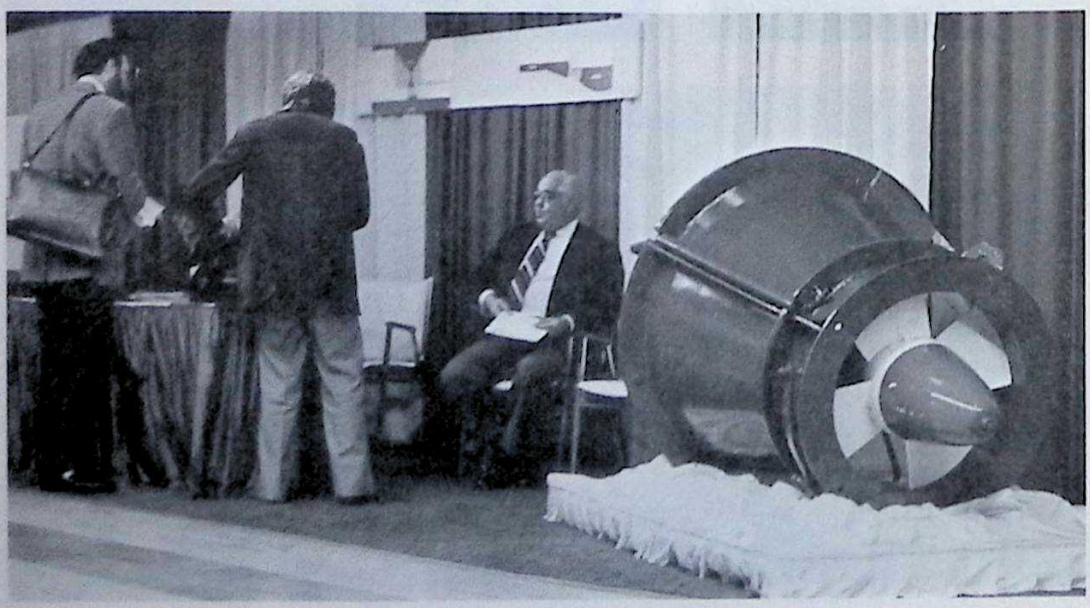
Institute of Electrical and Electronics Engineers, Inc.
National Society of Professional Engineers
American Society of Civil Engineers
American Society of Mechanical Engineers
Society of American Military Engineers

CONFERENCE PLANNING AND MANAGEMENT SUPPORT

International Science & Technology Institute, Inc., Washington, DC

WATERPOWER '79

EXECUTIVE SUMMARY



I. CONFERENCE PROFILE

Waterpower '79 was held October 1-3, 1979 at the Washington Hilton Hotel, Washington, D.C.

PURPOSE

The purpose of the conference was an exchange of information among those in the public, private and international sectors who are either actively working in hydropower or have a strong interest in the subject.

ATTENDANCE

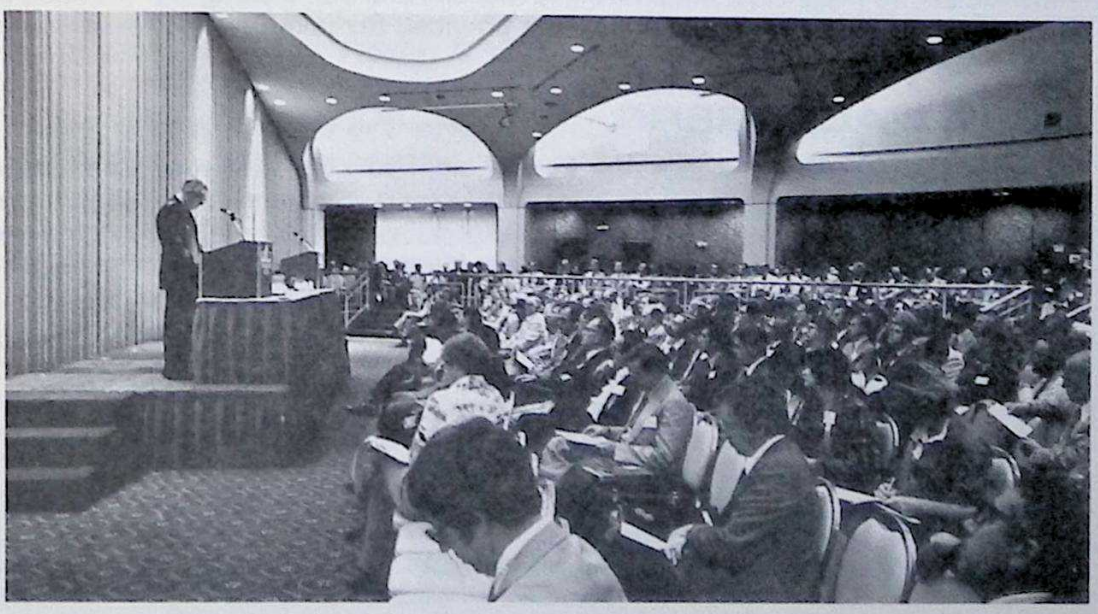
The attendance exceeded 1200 and included representatives from many sectors—Federal Government, State and Local Government, Architect-Engineer firms, financial institutions, utilities, associations, U.S. and foreign manufacturers, universities, international organizations, foreign countries, and many others

TECHNICAL PROGRAM

The technical program consisted of: a White House executive address; plenary sessions dealing with topics in engineering, policy, planning and international experiences; two special Congressional addresses; twenty-three technical sessions in which eighty-nine papers were delivered in topics ranging from social, economic and environmental concerns to innovation, facility design and international assistance; thirty-two exhibition booths and a film and slide theatre; and workshops which were offered on a repeating basis and dealt with topics on financing and marketing, planning, development policy and legal context, government funding, licensing, engineering, dam inspection, and environmental issues.

SPECIAL EVENTS

An exhibitors' reception with canape's and drinks in the exhibit hall, a Congressional reception for 1200 - 1300 was held on the Hill and catered by the Senate caterer, and a conference luncheon was held featuring as guest speaker, the Chairman, Hydraulic Resources Division of the World Energy Conference Commission on Energy Conservation.



II. CONFERENCE FINDINGS

POTENTIAL

There is considerable potential for hydropower development via upgrading, retrofit and new work in both the U.S. and other countries.

- U.S.—Northeast, Southeast and Lake Central areas have the most potential with roughly 5,000 MW at 4,800 sites, most of which are in New England.
- Examples of countries that are actively installing and/or inventorying small-scale potential include, New Guinea, Peru, Peoples' Republic of China, and others.

METHODOLOGIES

Technical methodologies have been and are being developed at universities, research institutes, regional, federal and state government agencies in such topics as hydrologic and hydraulic based feasibility assessments, computer assisted techniques for inventories, modeling and various approaches to environmental, economic and social assessments.

INTEREST

The interest in small-scale hydropower is part of the larger interest in technologies utilizing renewable energy resources. The large conference turnout of over 1200 when 700 were expected, the large number of international requests for conference proceedings, the heavy attendance at DOE regional workshops in hydropower, the formation at WATERPOWER '79 of a professional society of small-scale hydropower, and the inundation of FERC with license applications and requests for information all indicate a growing interest in small-scale hydropower.

ROLE

The role for hydropower in the future while not a major energy supply is an important one. Relatively inexpensive energy, minimal environmental damage and the ability to provide large centralized as well as small decentralized power will help our energy supply system.

This role has been assured by both the Administration as well as the Congress. Recent initiatives from the President are designed to provide hydropower to rural America and to install low head turbines in locks and dams along the Mississippi River. Legislation from the Congress has provided tax incentives for developers.

MANUFACTURERS

Vendors are continuing to develop new equipment appropriate to small-scale hydropower. Turbines are being marketed which are designed for low flows, low heads and have standard sizes. Breakthroughs lowering power house costs are continually pursued. U.S. manufacturers are competing in the world market, but they must also compete with foreign manufacturers at home.

CONFERENCE CO-CHAIRMAN

LTG JOHN W. MORRIS
Chief of Engineers
U.S. Army

"Since 1900 we moved across the country from coast to coast like a giant machine harvesting the choice hydropower sites."

"Hydroelectric power development at many dam projects which had not been economically feasible in the past, have suddenly become attractive investments."

"We are now retracing our steps, gleaning the potential power sites we overlooked before the escalating cost of fossil fuels made hydropower more competitive."

"There are five Corps power projects under construction which will have an installed capacity of almost 1.4 million KW. Four power projects now in operation have authorized power additions. There are 9 power projects authorized, but not yet under construction. Nine existing power projects will require authorization to install additional units. Fifty existing projects have potential for installation of power generating units. Finally, 35 potential projects not yet authorized have a power potential greater than the Corps current installed electric capacity."

"The development of all of these potential sources of hydropower would more than triple the current generating capacity at Corps projects."

"We have been working closely with the Department of Energy as this jointly-sponsored symposium shows. We are developing the data base on which a sound national hydropower development program can be planned and executed. The cooperation of many Federal, State and local interests is essential to the achievement of that goal."

"The Corps of Engineers has the organization and capability to interface effectively with the private sector in the development of water resources, including hydropower. Its network of field offices reaches all sections of the country. The Corps is used to working effectively with State and local officials and individuals in its many programs involving planning, cost sharing, public participation and regulatory functions. Our track record for obtaining the cooperation of the public and private sector is a good one. I pledge the full cooperation of the Corps in the development of our total national hydropower potential."

CONFERENCE CO-CHAIRMAN

GEORGE S. McISSAC
Assistant Secretary for
Resource Applications
U.S. Department of Energy

"The most urgent aspect of the energy problem is our over dependence—I think of it as an addiction—to oil, particularly imported oil."

"We still must provide energy to support our industrial base and provide for the legitimate needs of our people. Thus, we must develop alternative sources of energy."

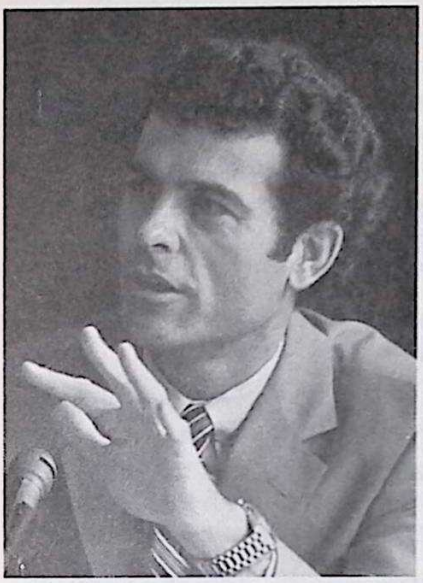
"This is the context in which we view small hydro. It is an available source of energy that has not been fully exploited. . . . It is reasonably economic, environmentally benign and directly applicable to power generation. It is part of the solution."

"There are four impediments to the widespread use of small-scale hydropower. These are: (1) lack of knowledge about the size, location and nature of the resource base; (2) lack of understanding of the pricing aspects of small-scale hydropower; (3) lack of proof, through actual demonstrations, that modern small-scale hydro technology works; and (4) difficulty of transferring information to potential decision makers."

In order to overcome these barriers, DOE has structured a four-part program:

1. *Special studies:*
   - *impediments to development and incentives for power-on-line*
   - *national assessment of small-scale hydro*
   - *state surveys*
   - *technical overviews*
   - *cost reduction and extended technology*
   - *implementation of state hydro legislation*
2. *Grants for feasibility studies and licensing assistance*
3. *On-going and planned demonstration projects*
4. *Regional informational workshops and developing user documents.*

EXECUTIVE ADDRESS



JACK H. WATSON, JR.
Assistant to the President for
Intergovernmental Affairs and
Secretary to the Cabinet
The White House

"The energy challenge, I think, poses some very fundamental questions to us . . . it poses questions about our capacities to respond to change, to discipline ourselves, our capacity to be a generation of Americans and citizens of the world on the . . . cutting edge of an era, the outlines of which we cannot, do not perceive yet."

"We have a kind of mega solution syndrome in a time in which there aren't any mega solutions. It's a syndrome from which we must escape."

"We need to do many things in the energy area, things of a dispersed nature that need to be done by local communities, with local initiative, for local pay-off . . . I am predicting, I think absolutely safely, that our attention has turned, and will continue to turn, to the smaller scale effort."

". . . They involve no new environmental impacts, generally speaking.
. . . They are virtually non-polluting.
. . . They are using a renewable resource.
. . . They are small and, almost invariably can be aesthetically acceptable, even pleasing.
. . . The technology for the hydroplants is established.

"Part of the benefit which I hope will result from a conference and other conferences like this one will be an exchange of expertise and technical knowledge with respect to the standardization and mass-production of that small scale hydroelectric power generation."

"It's interesting to note, and important I think, that A.I.D. in this country as well as the international finance community at large are recognizing increasingly the potential for small-scale hydropower and they are expressing interest in participating in the implementation of projects identified in those assessments."

". . . This energy crisis . . . gives us a chance to reexamine, at a pivotal moment, just exactly what kind of legacy we want to leave to our children and their children."

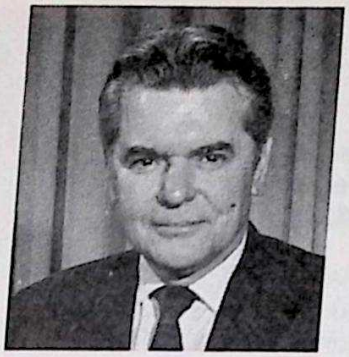
III. THEMES & TOPICS

A number of themes with key topics were woven through the conference fabric. The general conference spirit was one of optimism.

- engineering is meeting the challenge with such items as turbines requiring no dam, turbines designed for low head, standardized sizes, and so on.
- incentives are beginning to be developed through legislation for licensing exemption for facilities with small size and special purpose, for ownership transfer and for government subsidies through grants, loans and low tax rates.
- government planning programs are identifying opportunities through many state activities and Federal programs in the Corps, Water and Power Resources Service, Water Resources Council and others.
- problems exist, but are being identified and dealt with—environmental mitigation costs, financial assistance, marketing, powerhouse costs, for example.
- demonstration projects show where problems will occur, but also show it can be done in the case of new equipment, ideas, etc.
- many countries have much to offer either in the way of experience with small-scale hydropower or in potential for development.
- many analytical techniques exist or are being developed for planning, inventories, field surveys, economic assessments, hydrologic potential, environmental impacts, and so on.
- financial opportunities exist through the private sector also, via long term loans, and low interest rates to individuals and companies.

IV. TECHNICAL PROGRAM

Engineering



PLENARY

". . . small hydroelectric development is not only an idea whose time has come, but is also a practical and feasible energy development whose time has come."

NORMAN M. CLAPP
Former Administrator
Rural Electrification Administration
U.S. Dept. of Agriculture

There is considerable encouragement in the size of the total small-scale potential available. Of 54,000 dams surveyed the Corps found that roughly 10 percent, 5,424 sites, were technically feasible. Preliminarily, the capacity of these sites has been put at 94,636 MW.

DOE demonstration sites are also showing encouraging feasibility results. Of 54 studies, 60% were found to be feasible, though many were marginal. Facility costs generally ranged from $1000 to $2500 per kilowatt and energy costs from 20 to 45 mills. Additional demonstration projects are underway, with an expanded loan program for feasibility studies and licensing costs. Recent program opportunity notices have gone out seeking proposals for both larger scale demonstration studies as well as innovative demonstration projects.

Currently pending legislation would, if enacted in present terms, provide tax credits for small hydro facilities at existing dams of 25 MW or less capacity, including added investment tax credits for fish ways, transmission facilities, turbines, and civil works. It would also permit accelerated depreciation on small hydro facilities.

PANEL

Howard A. Mayo, Jr., *Marketing Development, Allis-Chalmers Corp.*
David C. Willer, *Manager, Water Resources, Tudor Engineering*
Robert H. Bruck, *Chief, Electrical & Mechanical Branch, Engineering Division Corps of Engineers*
William Love, *Superintendant of Utilities, Vanceburg, Kentucky*
William Lawson, *Director, Office of Technology Assessment and Forecast, U.S. Patent Office*

PAPER SESSIONS

Equipment — *small hydropower equipment for development and operation.*

Redevelopment — *existing facilities, historic sites — planning and structural considerations, application of "Mini Units", dam safety, retired plant potential and minimizing capital costs.*

Generation systems — *power station operation, equipment and new developments.*

Hydraulics and hydrology — *techniques for investigation, planning, design and problem analysis.*

New ideas, concepts and technology — *low velocity water currents, hybrid power plants, site built components and new applications, identification of research, hydraulic ram, hydropower without dams, appropriate technology.*

Development and operations economics — *busbar costs, evaluation of small-scale plants, conceptual run of river model and comparative project economics.*

Planning, Information and Methods

PLENARY

"Low-head hydro could conceivably produce all of the energy necessary by electric cooperative systems in this country to 1995."

ALEX P. MERCURE
Assistant Secretary for Rural Development
U.S. Department of Agriculture

In the past several years there has been tremendous growth in small communities in rural America. According to demographers, small towns are now growing, generally about twice as fast as our big cities. There has also been a tremendous diversification in the location of America's industry and REA is an important, though not exclusive, element in that development.

If, for their $10 million, DOE was able to finance only 100 demonstration plants which averaged 5 MW, they would produce a total capacity of 500 MW. In REA, 500 MW of capacity would represent $500,000,000 in loans. That gives some idea of how important it is to aggregate these diverse sources of energy.

It's time to think about what small units aggregated and dispersed could do—it isn't difficult for REA to integrate small quantities of electricity, particularly if it's baseload, into the transmission systems that those electric coops already have. Small irrigation diversion dams and larger erosion control dams have power producing potential.

The coops are beginning to show an impressive initiative not only in hydropower, but in a range of several solutions to help capture the waste of energy.

PANEL

Robert Cross, *Administrator, Alaska Power Authority*
Ronald Corso, *Deputy Director, Licensed Projects, Federal Energy Regulatory Commission*
Jerry D. Priscolli, *Sr. Social Scientist, Institute for Water Resources, Corps of Engineers*
Mike Spear, *Associate Director, Environment, U.S. Fish & Wildlife Service*

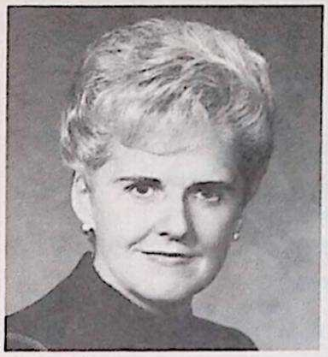
PAPER SESSIONS

Social and Environmental Analyses — *community impacts, historic preservation, fish passage technology, employment possibilities, assessment methodologies, water level fluctuations and institutional arrangements.*

Planning for development — *inventories, resource assessment, screening methodologies and statewide coordination, planning hydro additions, financial planning, state planning and optimizing feasibility studies, factors affecting feasibility, mapping systems, evaluation models and supporting services.*

Case studies and demonstration projects — *feasibility investigations, innovative state legislation, powerhouse reconstruction, unit size selection, tidal power, power projects and preliminary feasibility studies.*

Policy



PLENARY

"Clearly, small-scale hydropower can play a major role in a short term solution of our energy needs. And it must be a vital part of our long term energy program."

GEORGIANA SHELDON
Commissioner
Federal Energy Regulatory Commission

The Commission has made recent efforts to simplify and expedite the licensing process. In September of 1978 the FERC simplified the licensing procedure for power projects with a capacity under 1.5 MW which lessens detail and information required, and revises comment procedure. In March 1979 requirements were put forth which simplified filing related to amendments, cancellations and reducing exhibits from 9 to 4. In April 1979 procedures were proposed which streamlined the processes at existing sites, reducing exhibits from 23 to 7. A final phase of reform in FERC licensing will apply to new projects of capacity greater than 1.5 MW.

In April 1979 FERC exempted licensing requirements of projects 15 MW or less located on man-made conduits for generating power only.

Some 17 different federal statutes have vested various federal agencies with jurisdiction over some aspect of hydropower. A successful program must involve the cooperation of other agencies, special interest groups and licensees as well. State and Federal agencies must devise new processes of interagency coordination so that required considerations are expeditiously carried out in the public interest.

Licensees must recognize and accept the responsibilities and obligations of utilizing a public resource, availing themselves of agency staff expertise and entering into effective dialogue with special interest groups.

PANEL

Alex Radin, *Executive Director, American Public Power Association*
Leo Eisel, *Director, U.S. Water Resources Council*
Robert Smythe, *Sr. Staff, Council on Environmental Quality*
Lawrence F. Kramer, *Mayor, City of Paterson, N.J.*

PAPER SESSIONS

Public and private finance & policy issues — *recommendations, constraints and marketability*

Water: Management and use — *potential considerations, water rights, planning guidelines and policy recommendations.*

Environmental issues and impacts — *small scale impacts, DOE's program plan, land use consideration and legislation.*

Energy — *institutional, economic and environmental constraints, future alternatives, generation in rural areas and application to a utility system.*

International Perspectives

PLENARY

"I am devoted to hydropower. It is the most exciting professional subject . . . implementation of hydropower projects require the broadest application of several disciplines of engineering."

EMIL F. MOSONYI
Professor, Hydraulic Engineering
University of Karlsruhe
German Federal Republic

In the world, in many countries, not only the small-scale dam power plants, but also the typical low-head, run-of river stations located on low gradient streams will gain in importance.

In all stages of hydropower construction the process has been accelerated, particularly in the phases of foundation and tunneling works, machine assembly at site and prefabrication. Economic stimuli for water power utilization have been provided by advances in tunneling techniques. Examples of underground projects exist in Canada, Austria, Sweden, Norway, Italy and Switzerland.

Many river stretches and dam sites can be selected which have not been realized before as offering the chance for hydropower implementation. From the economically feasible potential of 4 million MW, only roughly 10% has been presently utilized.

Several aspects will contribute to a successful program in small-scale hydropower: true allocation of investment, realistic assumptions of equipment and structure lifetimes, up-to-date assessment of plant capacity, future contingency planning, feasibility study requirements in balance with economic and human values, midget plants that do not require sophisticated equipment, reduced planning and construction time, hydropower as an integral part of engineering education, and accelerated decision-making.

PANEL

Peter Bourne, *Assistant Secretary General, UN Water Decade*
Charles Weiss, *Science Advisor, World Bank*
Alan B. Jacobs, *Director, Energy Office, AID*
Francis X. Gannon, *Advisor to Secretary General, OAS*
Ricardo Saettone, *Director, Superior Vice Minister of Energy & Mines, Peru*

PAPER SESSIONS

Development experiences — *regulation comparison, non-oil producing nations, foreign aid for developing countries and development in the Peoples' Republic of China.*

Technology — *experience with small-scale turbines, appropriate technology and viable alternatives.*

V. WORKSHOPS

Eight workshops were held several times each during the conference. Each session lasted approximately 2 hours with a panel presentation followed by audience interaction.

The workshops and example topics with which they dealt were:

Finance and Marketing

Chairman: David Auslam, Auslam & Assoc.

Financing hydro projects, raising private backing, tax credits, investment bankers, marketing and calculating investment return.

Planning

Chairman: David Willer, Tudor Engineering

A feasibility study locating information and resources, designing, planning and implementing a project, converting into a utility grid, and wheeling power.

Developing Policy/Legal Context

Chairman: Peter Brown, Franklin Pierce Law Center

Identifying Federal, State, regional and municipal policies, government regulations, conflicting water uses.

Government Funding

Chairman: Ralph Burr, U.S. Dept. of Energy

Obtaining government funds, government programs.

Licensing

Chairman: Ronald Corso, Federal Energy Regulatory Commission

Applying optimal resource use, inspections, engineering and economic studies, preliminary permit, feasibility.

Engineering

Chairman: George Smith, U.S. Dept. of Energy

Assessing requirements, stream potential, power system, automatic vs. semi automatic.

Dam Inspection, Safety and Adequacy

Chairman: Robert Philleo, U.S. Army Corps of Engineers

Assessing a dam structure, matters and considerations to address.

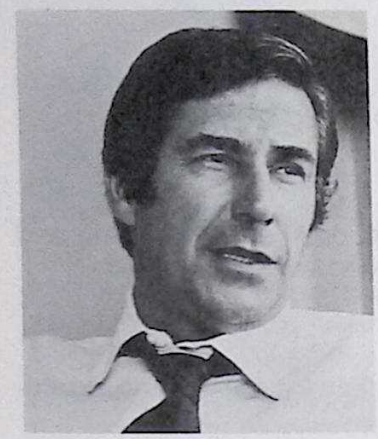
Environmental Issues

Chairman: Stephen Hildebrand, Oak Ridge National Lab

Issues affecting development, mitigation, issue solution, impacts, and regulations.

VI. SPECIAL PRESENTATION

Special addresses were given to the attendees of Waterpower '79 by members of the Congress and the World Energy Conference.



HON. MIKE GRAVEL
D-Alaska
U.S. Senate

The outlook for hydropower as an alternative energy source in the 1980's is integrally tied to the overall consideration and development of a comprehensive and effective national energy policy. To assess the future of hydropower in the next decade, it is necessary to understand and consider the current direction of this country's energy policies.

The development of hydroelectric power has always been subject to the market. Hydropower provided the foundation for the industrial development of this Nation and continued to grow until the regulation of natural gas took hold in the early 1960's.

In August Senator Mark Hatfield and Senator Gravel were joined by several other Senators in introducing Senate Bill 1641, the Small Hydroelectric Power Development Act of 1979. This bill will set up a continuing authority for the Corps of Engineers to site select, plan, design, and construct new low-head hydroelectric facilities. This authority is set up on a turn-key basis with the non-Federal entity owning and operating each facility and agreeing to pay back 100 percent of the Federal cost of construction plus interest over a fifty year period. Projects constructed under this act shall be limited to an installed capacity of twenty-five magawatts.

Most important, Senate Bill 1641 is designed specifically to provide small low-income communities with a source of renewable energy immune to rising oil prices. These projects will help provide such communities with a stable economic base for economic development in the 1980's.

SPECIAL PRESENTATION

HON. JOHN A. DURKIN
D-N.H.
U.S. Senate

In the state of New Hampshire it has been suggested that up to a third of the electrical power can be generated by retrofitting existing dams and taking advantage of some of the flood control dams.

Hydropower is currently very economical, but future costs of pursuing oil-based emergency energy resources, particularly in terms of military security, are equally important. By 1984 and perhaps sooner the Soviets will stop exporting one million bbls of oil per day to the West, they will become importers of oil and the pressure on the price and availability in the Middle East and elsewhere in the OPEC countries is going to be tremendous.

There are several things we must work on; make money available for loan guarantees; increase the investment tax credit for the businessman and the entrepreneur; set equitable power rates in the utility section; provide incentives to power generated from small-scale hydro and other small alternative energy sources; assist municipalities through loan guarantees.

We must use energy efficiently, otherwise we're not going to preserve economic standards and be independent.

The states can do a lot to help. The closer the spending of the money is to the taxpayer, the more efficient the distribution and utilization of the money.

"We are the most efficient in the world, but also the most energy intensive in the world. . . . inflation is hitting the necessities and it's primarily energy induced. We are never going to get it under control in my area of the country until we solve the energy problem. Hydro has a tremendous potential."

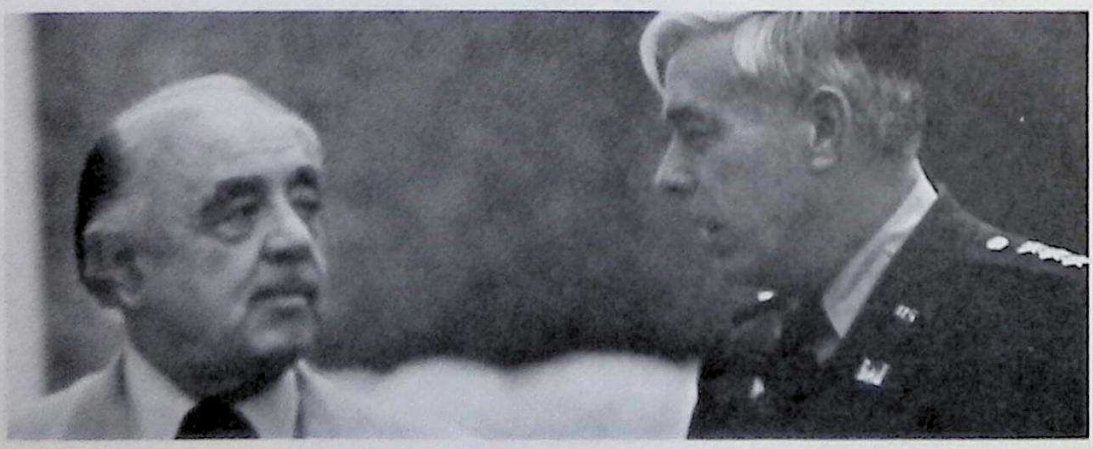
SPECIAL PRESENTATION

ELLIS L. ARMSTRONG
Chairman, Hydraulic Resources Division
World Energy Conference Commission on Energy Conservation
(Former Chairman, U.S. National Committee of The World Energy Conference)

The potential of developing small-scale hydropower is promising, but as with most things, there is no magic. Accomplishment takes work and effort and time. The challenges for development to occur become more difficult and more widespread as we have more people. And this is a fact that no fantasy or wistful thinking is going to change; more and more and more people are coming down the road.

The World Energy Conference Conservation Commission study concluded that the worldwide hydropower installations will increase about five times by 2020. It is expected the present 60,000 MW will be about double in the United States.

The challenge is for all of us to more realistically face up to the fundamental problems of mankind in order to meet the needs of the growing numbers of people in our world. Meeting the needs of people, both in the developed and the undeveloping countries, basically involves energy, water, and food; interrelationships are varied and complex. For instance, in the more affluent countries where food supplies seem assured, at least for the present, the emphasis is directed toward a fuller life, including increased services and cultural activity in an unpolluted quality environment. This requires greater energy from cleaner sources, and better management and control of water. In the developing countries, the emphasis is on adequate food, goods and services that reduce risks to life, and improve human conditions so that life is less arduous and more worthwhile. Worldwide, all are striving toward individual betterment, justice, harmony, and peace; these goals require economic growth and improvement, and this requires increased use of energy and better and increased utilization of water.



VII. WHERE DO WE GO FROM HERE

1. Results from current studies by the Corps of Engineers, Water and Power Resources Services, New England River Basin Commission and others will soon determine the feasibility and potential of hydropower and additional demonstrations funded by DOE will exhibit innovation, test equipment and prove economic viability. These results will lead the way for viable programs for both large and small-scale development.

2. Legislation is continuing to be developed which will assist in streamlining government agency procedures and providing technical assistance and incentives to private and public developers.

3. The attention of decision-makers must continue to be kept on the viability of small- scale renewable energy resources such as hydropower and efforts to refine and innovate the technology must go forward.

4. In order to maintain the momentum for international information exchange in hydropower, Waterpower '81 is being planned.

Date: June 22-24, 1981
Location: Shoreham Hotel, Washington, D.C.
Program: Plenaries, Papers, Workshops, Exhibits, Special Events
Sponsor: Corps of Engineers and other organizations interested in co-sponsoring or cooperative assistance

For more information, contact:

Waterpower '81
2033 M Street, N.W.
Suite 300
Washington, D.C. 20036

REPRESENTATION AT WATERPOWER '79

States — 46

Alabama
Alaska
Arizona
Arkansas
California
Colorado
Connecticut
Florida
Georgia
Hawaii
Idaho
Illinois
Indiana
Iowa
Kentucky
Louisiana
Maine
Maryland
Massachusetts
Michigan
Minnesota
Mississippi
Missouri
Montana
Nebraska
Nevada
New Hampshire
New Jersey
New York
North Carolina
Ohio
Oklahoma
Oregon
Pennsylvania
Rhode Island
South Carolina
Tennessee
Texas
Utah
Vermont
Virginia
Washington
Washington, DC
West Virginia
Wisoncsin
Wyoming

Countries — 22

Austria
Canada
China (Peoples Republic)
Egypt
England
Finland
France
Germany(West)
Israel
Jamaica
Japan
New Guinea
Norway
Panama
Peru
Philippines
Portugal
Puerto Rico
Scotland
Spain
Sweden
Switzerland

Registration at WP '79 by Sectors

[decreasing frequency]

1. Federal Government
2. A-E Firms
3. U.S. Manufacturers
4. Consultants
5. Universities
6. Foreign Manufacturers
7. State Governments
8. Local Governments
9. Public Utilities
10. Foreign Governments
11. Private Utilities
12. International Organizations
13. Private Individuals
14. U.S. Finance
15. Special Interests (Energy)
16. International Finance
17. Congress (Staff)
18. Trade Associations
19. Special Interests (Environment)
20. Special Interests (Other)

EXHIBITORS

Acres American Incorporated
Suite 329, Clark Building
Columbia, MD 21044

Allis-Chalmers Corporation
Box 712
York, PA 17405

ASEA, Inc.
4 New King Street
White Plains, NY 10604

Axel Johnson Corporation
1 Market Plaza, Suite 445
San Francisco, CA 94105

BOFORS-NOHAB, Inc.
One World Trade Center
Suite 10225
New York, NY 10048

Brown Boveri Corporation
1460 Livingston Avenue
North Brunswick, NJ 08902

Charles T. Main, Inc.
Southeast Tower
Prudential Center
Boston, MA 02199

General Electric Company
One River Road
Building 23-254
Schenectady, NY 12345

Hydro Research Science
3334 Victor Court
Santa Clara, CA 95050

Independent Power Developers
Route 3, Box 285
Sandpoint, Idaho 83864

KVAERNER-BRUG A/S —
SORUMSAND VERSTED A/S
800 Third Avenue
New York, NY 10022

Leroy-Somer, Inc.
405 W. University Drive
Arlington Heights, IL 60004

McKay Water Power Limited
P.O. Box 448
Port Colborne,
Ontario, Canada
L3K 5X7

Morrison-Knudsen Co. Inc.
One Morrison-Knudsen Plaza
P.O. Box 7808
Boise, Idaho 83729

Oy Tampella Ab
c/o Madden Service Corporation
9 Rockefeller Plaza
New York, NY 10020

Radiation Management Corp.
Ecological Division
3508 Market Street, Suite 400
Philadelphia, PA 19104

SOGREAH
BP172X38042
Grenoble, CEDEX, France

Sulzer Escher Wyss
200 Park Avenue
New York, NY 10017

TAMS
655 Third Avenue
New York, NY 10017

The Peoples' Republic of China
2300 Connecticut Avenue., NW
Washington, DC 20008

U.S. Army Corps of Engineers
20 Massachusetts Avenue, N.W.
Washington, DC 20314

U.S. Department of Energy
Idaho Falls, Idaho

U.S. Geological Survey
301 National Center
12201 Sunrise Valley Drive
Reston, VA 22092

Worthington Pump, Inc.
270 Sheffield Street
Mountainside, NH 07092

WATERPOWER '79 PUBLICATIONS

Conference Paper Proceedings

This publication contains a collection of all the technical session and plenary session papers, all special presentations, keynote address, executive addresses and workshop summaries. Copies may be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Conference Abstract Book

This publication contains a collection of all the paper abstracts for the technical sessions and an author index. Copies may be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Conference Tapes

All sessions of the technical program, plenaries, technical papers, keynote, executive, special addresses and the workshop sessions are recorded on tape. The price is $6.50 per cassette. Tapes may be ordered from: Eastern Audio Associates, Inc., 9505 Berger Road, Columbia, MD 21046.

For further information on other available hydropower publications, contact:

National Hydropower Study
U.S. Army Corps of Engineers
Institute for Water Resources
Kingman Building
Ft. Belvoir, VA 22060

Small Hydropower Applications
Room 3344
U.S. Department of Energy
Washington, D.C. 20461